

Side Air Bags

January 2002



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United States Department of Transportation

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NHTSA Publishes List of October 2001 Recalls - [Press Release](#)

U.S. Transportation Secretary Mineta Announces Launch Of Major Nationwide Campaign to Promote Tire Safety - [Press Release](#)

NHTSA proposes new standard for tire labeling to enhance consumer knowledge of tire safety and tire recall information. - [Posted 12/20/2001](#)

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The Research and Development (R&D) program serves as the foundation that supports the Agency's goal to reduce motor vehicle injuries and fatalities.

Through extensive research, development, testing, crash investigation, and data collection and analysis activities, R&D provides the scientific strength needed to support the Agency's motor vehicle and traffic safety goals.

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| Enhanced Safety of Vehicles (ESV) Presentations | Side Airbag Out-Of-Position Technical Working Group |
| National Association of Governors Annual Highway Safety Meeting | |

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Side Airbag Out-of-Position Technical Working Group Public Meeting

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| NHTSA Presentation | Presentor |
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| Side Impact Inflatable Restraint Systems: Real World Experience Of Side Impact Air Bags in the Special Crash Investigations | Augustus "Chip" Chidester |
| Evaluation of Injury Risk from Side Impact Airbags <download related AVI files here > | Aloke Kumar Prasad |
| Side Air Bag Research: Static Testing of Side Impact Air Bags Using Three and Six Year Old Hybrid III Dummies and the 12-Month CRABI Dummy | Aloke K. Prasad Randa R. Samaha Allison E. Loudon |

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- **Background**
 - Definition, Types, and Trends
- **NHTSA Evaluation Plan**
 - 13 Vehicles
 - Variations of TWG Procedures
 - Real World Effectiveness
 - Real World Risk
- **Status of Research**

Background

All Side Air Bags Not the Same ...

- **Thorax Bags**
 - . Seat Mounted
 - . Door Mounted
- **Combination Bags for Head / Chest**
 - . Seat Mounted
- **Head Bags**
 - . Roof Rail Mounted

Audi A6 seat mounted (thorax)



Volvo S80 seat mounted (thorax)



Cougar seat mounted (head & thorax)



Saab 9-5 seat mounted (head & thorax)



BMW Roof rail mounted (head)



Mercedes roof rail mounted (head)



Mercedes door mounted (thorax)



NHTSA's R&D Approach

- **Monitor Real World Risks Through SCI**
- **Conduct Static Tests to Evaluate Risks**
- **Conduct Dynamic Tests to Assess Benefits and Risks**
- **Enhanced Biofidelic Dummies**

Why Side Air Bags?

Not required in FMVSS 214...

- **Safer Vehicles**

- Offer Better Protection in Aggressive Vehicle and Narrow Object Crashes
- Better Side Impact NCAP Scores
- Rollover Protection (Ejection Mitigation)

Address Increased Risk of Head Injuries From Crashes Involving LTVs and Narrow Object



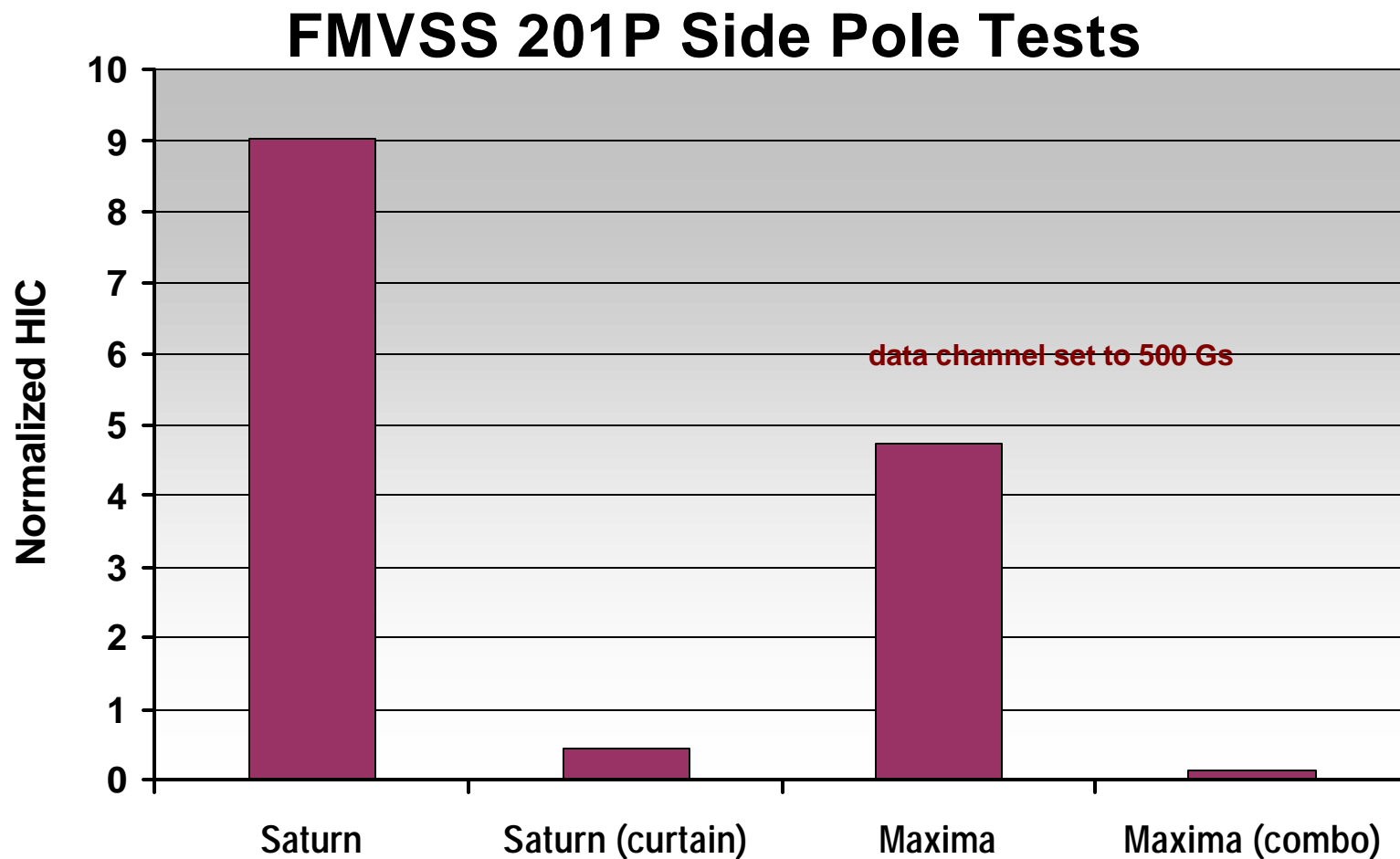
HIC=9,000, 2001 Saturn L200 no curtain

Address Increased Risk of Head Injuries From Crashes Involving LTVs and Narrow Object



HIC=435, 2001 Saturn L200 with curtain

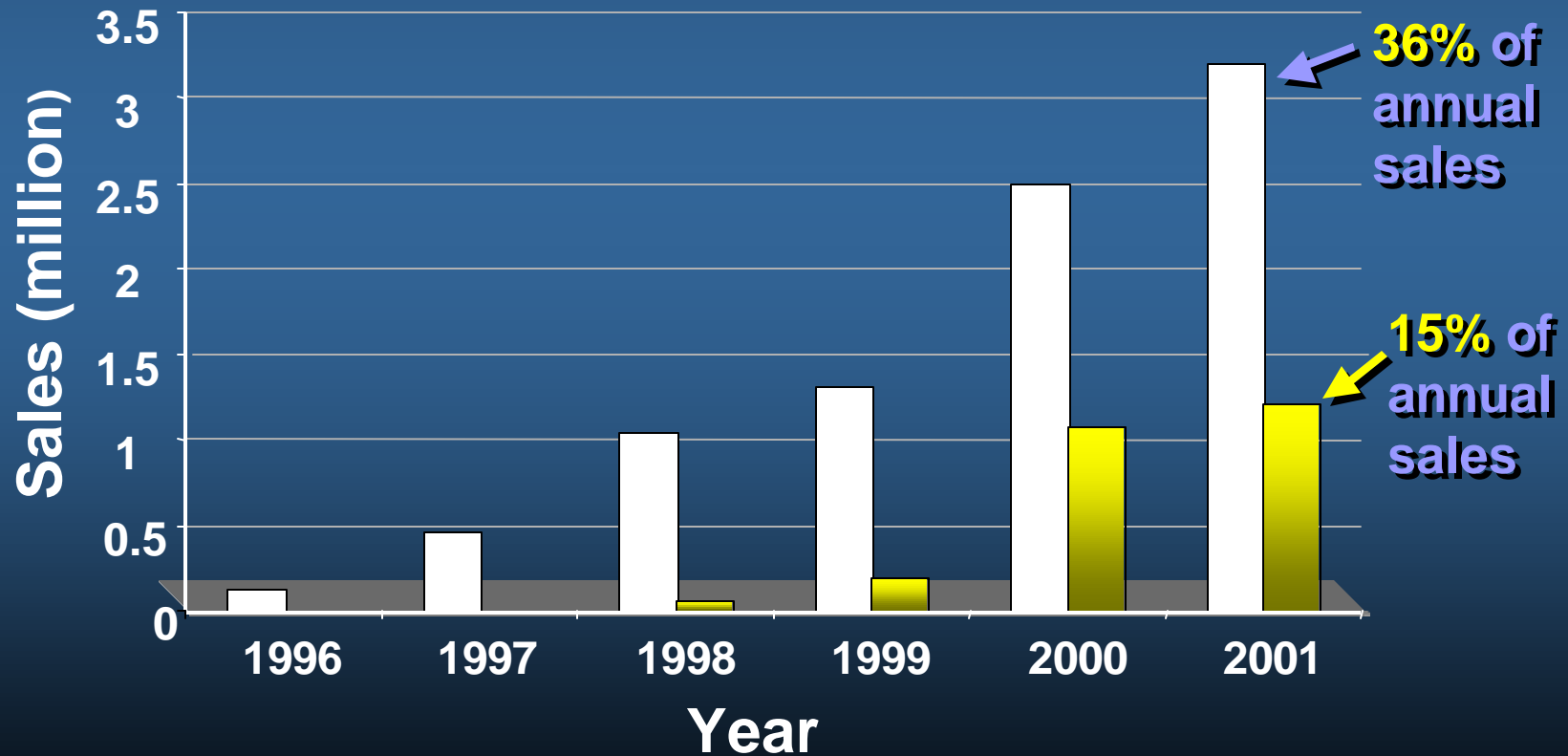
Address Increased Risk of Head Injuries From Crashes Involving LTVs and Narrow Object



Fleet Penetration of SABs

■ Cars
■ LTVs

Front Seat Side Air Bags



Special Crash Investigation Case Selection Criteria

- **High injury outcome with deployment of a side air bag**
- **Allegations of a fatal or seriously injured occupant attributed to the deployment of a side air bag**
- **Deployment of a side air bag into a position occupied by a child.**
- **Deployment of a head occupant protection system into an occupied position.**

SCI NHTSA Notifications

- **Special Crash Investigations (SCI) Program**
 - 3 teams, Headquarters
- **Fatality Analysis Reporting System (FARS) -**
 - 50 States, Guam & Puerto Rico
- **National Automotive Sampling System (NASS)**
 - 62 Sites, 24 CDS, 36 GES & 2 ZCs
- **Crash Injury Research and Engr. Network (CIREN)**
 - 8 Trauma Centers
- **Office of State and Community Services**
 - 10 Regional Offices
- **Office of Traffic Safety Programs**
 - Extensive Law Enforcement Network
- **Office of Defects Investigations**
 - Consumer Notifications Through the Auto Safety Hotline
- **Office of Public & Consumer Affairs**
 - Media



55 Side Air Bag Cases (10/1/01)

- **Side Impact Conditions - 43**
 - . Drivers 31
 - . Passenger 12
- **Other conditions where Side airbag Deployed - 7**
- **Rollover - 5**

Real World Experience

- **55 special crash investigations with SABs**
- **Several anecdotal cases of side air bags saving lives and preventing injuries**

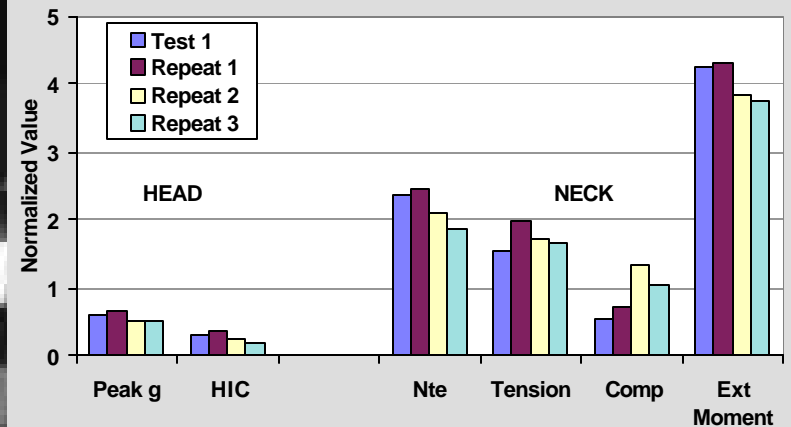
Real World Experience

- **No fatalities attributed to side bag deployment**
- **One seriously injured 76 y/o male (AIS 3 rib fractures due to cover flap, Deville no longer in production with door mounted SAB)**
- **The two cases with kids: the SAB provided protection (AIS 1 injuries)**
- **The head side air bag has been successful in reducing head injury**
- **Passenger compartment intrusion is the primary contributor to the fatal injury mechanism**

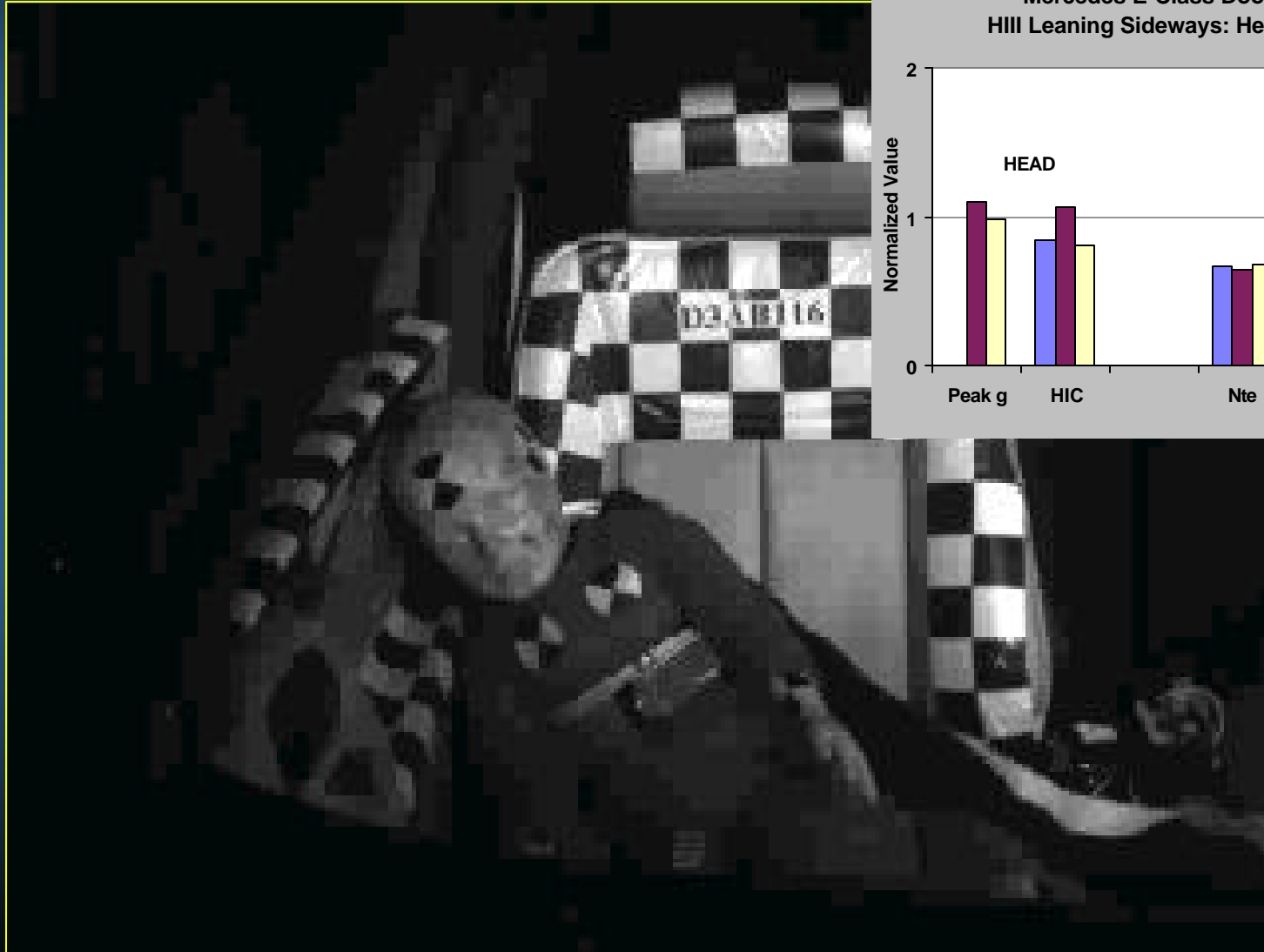
Early Assessment of Side Air Bag Risks



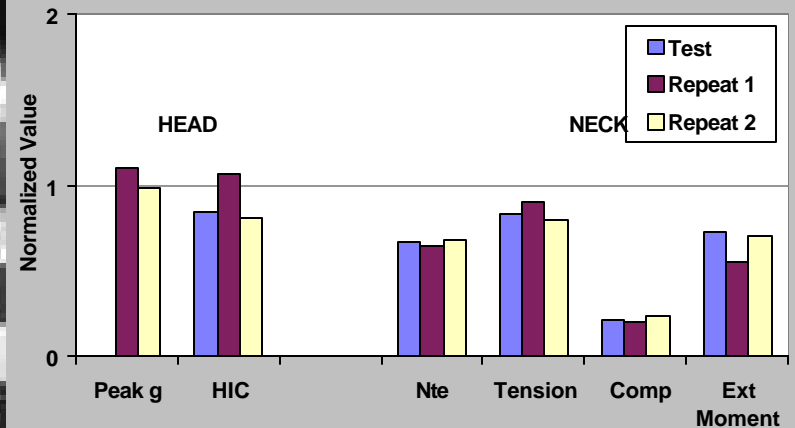
Mercedes E-Class Door Mounted Bag
HIII Kneeling, Facing Door Chest A-P Loading



Early Assessment of Side Air Bag Risks



Mercedes E-Class Door Mounted Bag
HIII Leaning Sideways: Head Lateral Loading



- **NHTSA**
 - Participated as observer
- **Transport Canada**
 - Participated as member
 - Developed test procedures
 - Conducted tests

Industry's Technical Working Group Approach

- **Use ISO Developed Procedures as Starting Point**
- **Modify ISO Procedures for Static Testing**
- **Use Available Frontal Child Dummies**
- **Use Injury Criteria Based on Expert Judgement**

TWG Activities

- **Identified Population at Risk**
- **Selected Available Test Dummies**
- **Established Dummy Injury Measures and Thresholds**
- **Set Associated Injury Risks for Children 5% for AIS 3 & 4**
- **Drafted Test Procedures**
- **Held Public Meetings**

TWG Injury Assessment

- **For 3 YO, 6 YO: Head, Neck, Chest**
- **For 5th %tile: Head, Neck, Chest, abdomen, pelvis, and arm**
- **Includes both injury criteria and injury research values**
- **Limits based on industry biomechanical expertise**
- **Minimizes risks for children**

Child Injury Criteria

- **Head - HIC (15 Msec)**
- **Neck – N_{ij} , Force and Moment Components**
 - Both upper and lower neck instrumentation
- **Chest – Acceleration and Deflection**
 - Chest deflection rates calculated

SAB OOP

Test Positions – Examples for 3 and 6 year old HIII dummies

3 yr Hybrid III



SAB OOP

Test Positions – Examples for 3 and 6 year old HII dummies

6 yr Hybrid III



Test Conditions-Vehicle Selection

| Seat Mounted | | Door Mounted | Roof Mounted |
|-------------------------|-------------------|------------------------|------------------|
| Thorax | Head/Thorax | | |
| 99 Geo Prizm | 99 Ford Windstar | 99 Cadillac Deville | 99 Volvo S80 |
| 99 VW Jetta | 99 Mercury Cougar | 00 Mercedes S430 (F+R) | 00 Mercedes S430 |
| 00 Audi A6 (F+R) | 00 Nissan Maxima | 00 BMW 528i (F+R) | 00 BMW 528i |
| 99 Volvo S80 | 99 Saab 95 | | 00 Audi A6 |
| 00 Cadillac Deville (R) | | | 01 Saturn L200 |

(F+R) = Front and rear seat air bags

(R) = Rear seat air bags

NHTSA Test Conditions & Positions

- **TWG recommended positions – Baseline**
- **Study high speed videos of “blank deployments”**
- **Develop additional test positions, variations of TWG positions, MCW positions**
- **Goal – most severe loads for dummies of various sizes**

Test Conditions- Dummies Used

- **Hybrid III 3 year old**
- **Hybrid III 6 year old**
- **SID-IIs**
- **12 month CRABI****
- **95% Adult Male****
- **All were instrumented with head, neck (upper and lower) and chest instrumentation**

****Not included in TWG procedures**

Status of Research

- 3 YO, 6YO, 12 month CRABI seat and door mounted SAB – completed
- Roof mounted bags including SID IIs & 95th% Adult Male – completed
- Seat and Door Mounted bags with SID IIs – ongoing

NHTSA

Dummy Positions

- Use “blank deployments” to see the deployment envelope of selected airbags
- Use TWG recommended positions
- Make modifications to get “worst case” for the vehicles, if needed
- With 20 different airbag setups, 3 YO, 6YO, CRABI, SID-IIs get ~300 planned test combinations plus repeatability (200+ completed)

NHTSA Positions and Dummies

- **Gets Head / Neck Closer to the Airbag**
- **Places Head / Neck at Different Locations Along the Seatback**
- **12 – 18 Different Positions Were Added**
- **Three Different Child Dummies and a 5th Percentile Dummy Used in Testing**

Dummy Implications

- The more Biofidelic Hybrid III 3YO neck can be used for:
 - Child Restraint Evaluation in lateral impact
 - Side Airbags OOPs evaluation
 - Generates more human-like lateral internal moments and external forces than the standard Hybrid III 3yo



Sled Test Kinematics

All frames at maximum head excursion.



HIII Standard Head/Neck



FTSS HIII-3CS Head/Neck



Denton HIII-3CS Head/Neck

Comparison of TWG & NHTSA OOP Test Position



TWG - 3 yr old leaning sideways on a foam booster block

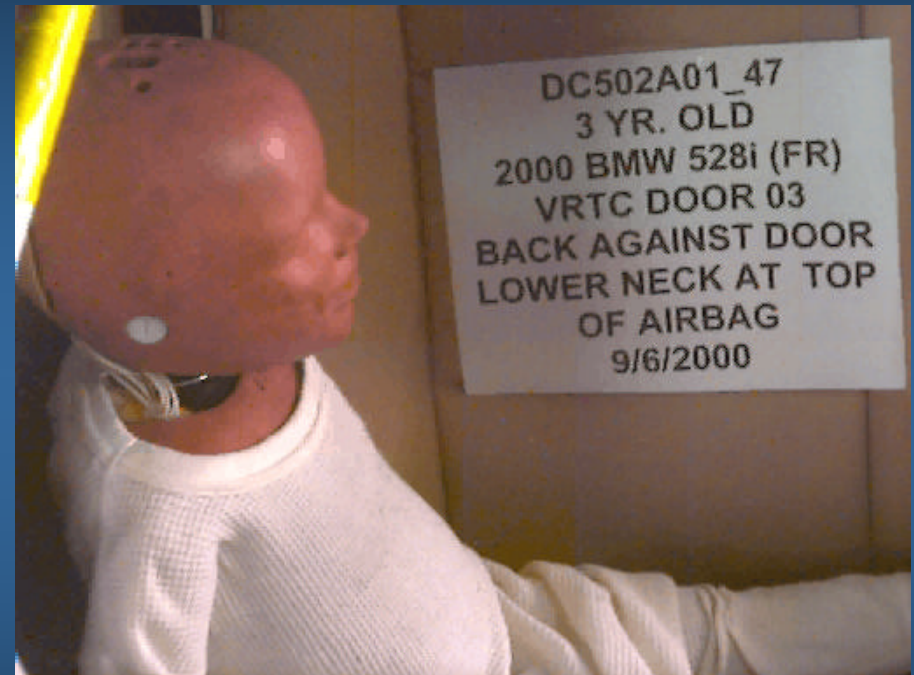


NHTSA variation - gets head closer to seat back & places head at different location along the seatback (resulted in high upper neck twist)

Comparison of TWG & NHTSA OOP Test Position



TWG Back Against Armrest



NHTSA variation - Back Against Door
Lower Neck At Top of Airbag

Rear Door Side Air Bags OOP Testing

NHTSA variation 3yo – high HIC



NHTSA variation 3yo– high N_{ij} , bending



Observations

- **3 & 6 YO - high loads possible in some SAB systems, especially from door mounted bags and seat mounted head-thorax combination bags.**
- **The TWG 3.3.2.2 (peek-a-boo) - good procedure for measuring injuries to the chest of 3 YO.**
- **TWG 3.3.2.1 (leaning sideways on a booster) - good for measuring the loads on the head-neck region of the 3 YO. In certain vehicles, the TWG position results in the head being away from the seat back.**

Observations (Cont.)

- Seat mounted air bags are located at different heights along the seat back. Additional positions place the head of the 3 year old at a range of locations along the seat back - helps in finding a test condition which produces more severe loads.



Observations (Cont.)

- **The dummy responses were low in the tests conducted with a properly restrained 12 month CRABI**
- **The dummy responses were low for all roof mounted airbags**

General Comments on TWG Procedures

- **IIHS Did a Good Job in Developing Consensus**
- **The TWG Procedures Are Quite Comprehensive and Are Successful at Discriminating Aggressive SABs**
- **The TWG Addressed Dummy Sizes, Positions, and Expanded Traditional Injury Assessment**
- **Generic Worse Case Position Will Not Always Be Absolute Worst Case**